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Fertilizers IN ALBERTA

FERTILIZER TEST, CARBON, 1955

PROVINCE OF ALBERTA
DEPARTMENT of AGRICULTURE

HON. L. C. HALMRAST
MINISTER

Publication No. 5

10M—7-59.

This publication has been prepared by the Alberta Advisory Fertilizer Committee and approved by the Alberta Crop Production Board appointed by the Honourable L. C. Halmrast, Minister of Agriculture. Members of the committee include representatives from the following :

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Experimental Farm Service —
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Field Crops Branch —
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Edmonton

Plant Products Division —
Canada Department of Agriculture

Fertilizer Trade —
Consolidated Mining and Smelting Co. Ltd.
Harrison's & Crosfield (Canada) Ltd.

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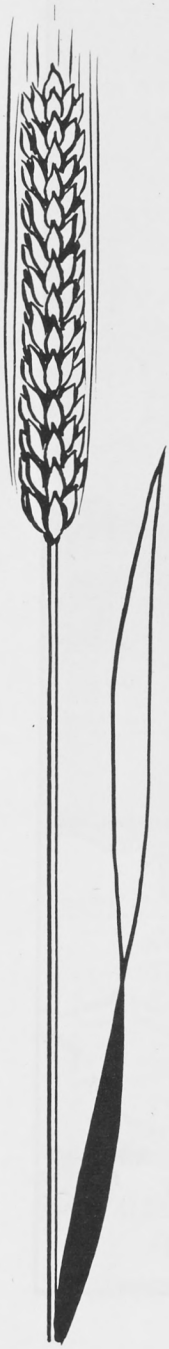
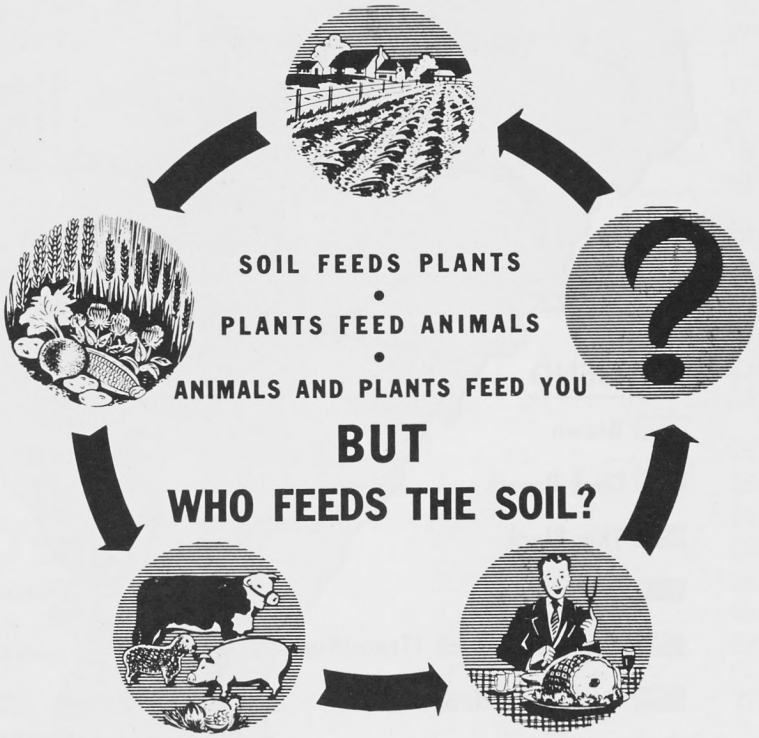
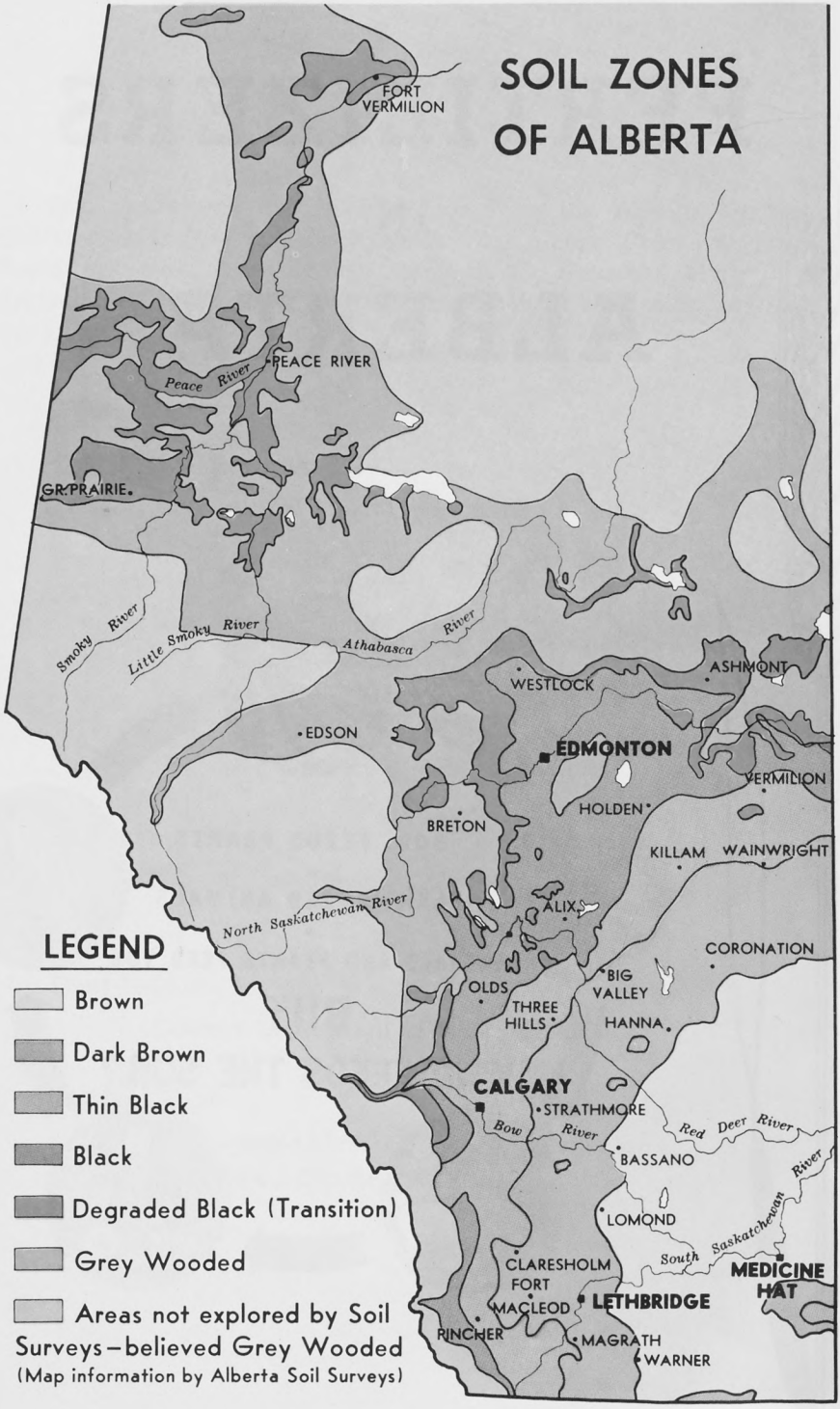
FERTILIZERS IN ALBERTA






SOIL ZONES OF ALBERTA
FORT VERMILION
PEACE RIVER
Peace River
GR. PRAIRIE
Smoky River
Little Smoky River
Athabasca River
WESTLOCK
ASHMONT
EDSON
EDMONTON
VERMILION
HOLDEN
BRETON
KILLAM
WAINWRIGHT
North Saskatchewan River
ALIX
CORONATION
BIG VALLEY
OLDS
THREE HILLS
HANNA
CALGARY
STRATHMORE
Bow River
Red Deer River
BASSANO
LOMOND
South Saskatchewan River
CLARESHOLM
FORT MACLEOD
LETHBRIDGE
MEDICINE HAT
RINCHER
MAGRATH
WARNER
LEGEND
Brown
Dark Brown
Thin Black
Black
Degraded Black (Transition)
Grey Wooded
Areas not explored by Soil Surveys – believed Grey Wooded
(Map information by Alberta Soil Surveys)

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FOREWORD

OUR soil is the foundation of our prosperity, progress and happiness. Deeply rooted in the soil is our independence, our safety and our welfare. We should maintain our soil in a highly productive state as an expression of good intentions towards nature and to our fellow men, including those not yet born.

Constant cropping without good fertility management exhausts the land. Plants take from the soil certain elements which they use as raw materials to build plant foods. When crops are sold off the farm, either directly or through live stock, fertility in the form of minerals obtained from the soil is removed. Fertility is also removed by soil erosion and leaching. To replace this fertility we must :

(1) Practise good cultural methods.

(2) Adopt a good cropping system, including legumes and grasses wherever possible.

(3) Make the best use of farm manure.

(4) Use suitable commercial fertilizers where recommended.

FERTILIZERS AND PLANT NUTRIENTS

PLANT nutrients are chemical elements which crops must obtain from the soil in adequate amounts if they are to grow satisfactorily. A fertilizer supplies one or more plant nutrient elements, of which nitrogen, phosphorus, potassium and sulphur are examples. Farm manure, green manures, legumes and commercial fertilizers are all used to supply one or more of these elements in order to improve crop yields.

Of the chemical elements which plants must obtain from the soil there are four which are most likely to be deficient in Alberta soils. These four elements are nitrogen, phosphorus, potassium, and sulphur. Each has specific essential roles in plant nutrition.

What nitrogen does:

- Gives dark green color to plants.
- Produces rapid growth.
- Feeds soil micro-organisms during their decomposition of low-nitrogen organic materials.
- May increase yields of leaf, fruit, or seed.
- May improve quality of leaf crops.
- May increase protein content of food and feed crops.

What phosphorus does:

- Stimulates early root formation and growth.
- Gives rapid and vigorous start to plants.
- Gives winter hardiness to fall-seeded grains and hay crops.
- Often hastens maturity.
- May stimulate blooming and aid in seed formation.

What potassium does:

- Imparts increased vigor and disease resistance to plants.
- Produces strong, stiff stalks, thus may reduce lodging.
- Increases plumpness of the grain and seed.
- Essential to the formation and transfer of starches, sugars, and oils.
- Imparts winter hardiness to legumes and other crops.

What sulphur does:

- Gives increased root growth.
- Helps maintain dark green color.
- Promotes nodule formation on legumes.
- Encourages more vigorous plant growth.
- May stimulate seed production.
- Often increases protein content of alfalfa and clovers by 1/10 to 1/4.

Calcium and magnesium and the six so-called trace elements all have their own specific roles in plant nutrition. However, tests to date have not yet found a general deficiency of any of these elements anywhere in Alberta.

Alberta soils in general appear to contain sufficient potassium. Responses to potassium have occurred only in isolated cases, mainly in peat fields.

NOTE : — Some common names are widely used when referring to compounds containing the chemical elements supplied by fertilizers. Examples follow :

Pure chemical element	Some common names applied to compounds containing element
Nitrogen	ammonia; nitrate
Phosphorus	phosphate; phosphoric acid; phosphorus pentoxide
Potassium	potash
Sulphur	sulphate

Manuring is a good practice.

FARM MANURE

Farm manure is one of the best fertilizers. It supplies not only plant nutrients, but it adds organic matter to the soil. This organic matter improves the physical condition of the land and helps it to hold moisture and resist erosion. Manure is rather low in phosphate, so phosphate fertilizers generally should be used on manured land for best results.

On most Alberta farms there is not enough manure to supply all the fertilizer needed, but even a limited supply can be used to advantage. Spread over as large an area as practical, manure will give greater immediate returns per ton than if spread heavily. Usually it is better to utilize 30 tons on three acres than on one acre.

Sweet clover provides good growth for green manure.

GREEN MANURES

Green manuring is another way to improve the soil Immature cereal or legume crops worked into the land add organic matter, improve the physical condition of the soil, and often increase the supply of available plant nutrients.

Green manures do not add any mineral which they have not previously taken from the soil, but the supply of nitrogen may be increased by ploughing under properly inoculated legumes. Inoculation introduces bacteria which, in association with the legume roots, change nitrogen of the air into compounds useful to both the bacteria and the legume. Cereal crops that follow also benefit from this increase of nitrogen in the soil.

Green manuring in Alberta should be limited to the following cases :

(1) On irrigated land, preferably using a legume.

(2) On grey wooded soils using a legume or a legume-grass mixture.

(3) Grain farmers often obtain beneficial results by seeding sweet clover with a grain crop using the sweet clover as a green manure in what would otherwise be a fallow year.

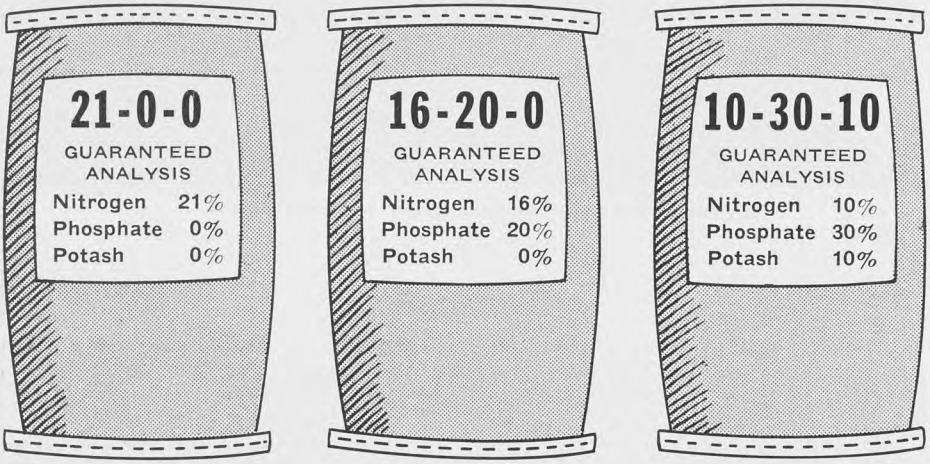
(4) In other areas of Alberta green manuring should generally be limited to legume and grass stands being broken up from hay or pasture.

On irrigated land and grey wooded soils the best results frequently are obtained by green manuring the entire legume crop. In other areas satisfactory results are obtained by allowing some regrowth after haying or pasturing. If the legume is plowed immediately after haying the benefit to subsequent cereal crops may not be so great. It is better to cut the hay early and if moisture conditions are favorable let the legume make some regrowth before plowing down.

A high analysis phosphorus fertilizer usually gives excellent returns on land that has been green manured with a legume.

COMMERCIAL FERTILIZERS

Commercial fertilizers are manufactured or processed products which contain one or more plant nutrient elements. They supply in concentrated form the same nutrients which plants obtain from the soil. Used in accordance with recommendations in this bulletin commercial fertilizers cannot injure the soil or crops in any way. A guaranteed analysis of the nitrogen, phosphorus and potassium content must be clearly indicated on the fertilizer bag or container. This ruling, provided under the Canadian Fertilizer Act, is for your protection and guidance.



WHAT'S IN THE BAG?

When buying a commercial fertilizer study the figures on the container and be guided by them. They may save you money. They show the percentage of nitrogen, phosphate and potash — and always in that order. For example, a fertilizer labelled 10-30-10 contains 10% nitrogen (N), 30% phosphate (P_2O_5) and 10% potash (K_2O). These figures show the major plant nutrients that you are getting, and with their help you can choose the fertilizer that will supply most economically the plant nutrient or nutrients you need. Most fertilizers also contain small quantities of some other plant nutrient elements which may be beneficial to plant growth, but these are not shown on the container. Sulphur is such an element, and some of our soils in Alberta need this plant nutrient.

From the cost of fertilizers the cost per pound for each of the various nutrients may be calculated as follows:

For nitrogen (N): If 1 ton of 35.5-0-0 costs $81.00 and contains 670 lbs. nitrogen, the cost per pound of nitrogen, in this fertilizer is approximately 12c.

For phosphate (P_2O_5): If 1 ton of 11-48-0 costs $107.00 and contains 960 lbs. of phosphate, the cost per pound of phosphate here is approximately 11c. (This calculation disregards the 220 pounds of nitrogen in a ton of 11-48-0. At 12c per pound 220 pounds of nitrogen are worth $26.40 and taking this into account the cost of phosphate becomes only 8.4c a pound.)

For potash (K_2O) : If one ton of 0-0-60 costs $81.00 and contains 1,200 pounds of potash the cost per pound of potash here is approximately 7c.

In Table 1, below, you will find the guaranteed analysis and the sulphur content of some of the fertilizers sold in Alberta.

TABLE 1

Information on Some Fertilizers Available in Alberta. 1959.

Name of Fertilizer	Guaranteed Analysis			Sulphur content %	Guaranteed plant nutrients per ton.		
	N% (Nitrogen)	P_2O_5% (Phosphate)	K_2O% (Potash)		N lb. (Nitrogen)	P_2O_5 lb. (Phosphate)	K_2O lb. (Potash)
Anhydrous ammonia	82	0	0	0	1640	—	—
Ammonium nitrate	33.5	0	0	0	670	—	—
Ammonium sulphate	21	0	0	25	420	—	—
Ammonium nitrate-phosphate	27	14	0	low	540	280	—
Ammonium nitrate-phosphate	24	20	0	low	480	400	—
Ammonium nitrate-phosphate	23	23	0	low	460	460	—
Ammonium phosphate-sulphate	16	20	0	14	320	400	—
Ammonium phosphate	11	48	0	low	220	960	—
Complete	10	30	10	5	200	600	200
Farm manure	0.5 (*)	0.25 (*)	0.5 (*)	low	10 (*)	5 (*)	10 (*)
Liquid fertilizer	7	14	7	low	140	280	140
Potassium chloride (muriate of potash)	0	0	60	low	—	—	1200
Potassium sulphate (sulphate of potash)	0	0	51	20	—	—	1020
Gypsum (calcium sulphate)	—	—	—	18	—	—	—
Sodium sulphate (dry)	—	—	—	22	—	—	—
Sulphur (commercial)	—	—	—	98	—	—	—

* Plant nutrients in manure vary with the kind and age of the manure.

ANHYDROUS AMMONIA

As a fertilizer for direct application to the soil, anhydrous ammonia is new to Alberta farmers. It is the basic material from which other nitrogen fertilizers are made and contains 82% nitrogen. It has replaced to some extent other forms of nitrogen such as ammonium nitrate or ammonium sulphate in parts of the United States where nitrogen is needed and application in the anhydrous form is the most economical method. Anhydrous ammonia is produced in Alberta.

At normal temperatures and atmospheric pressure, ammonia is a colorless gas that has a sharp penetrating odor. Under sufficient pressure anhydrous ammonia is a liquid. Tanks to hold the liquid should have a working pressure of 250 pounds per square inch, be equipped with suitable steel fittings and a safety valve.

When released in the soil anhydrous ammonia becomes a gas. Therefore it is injected into the soil at depths of four to seven inches to avoid loss of the gas to the air. Ammonia gas attaches to soil particles until taken up by growing plants or until it is converted into soluble nitrate by soil bacteria.

Anhydrous ammonia cannot be applied with the seed at seeding time as is commonly done with the dry fertilizers used in Alberta. Anhydrous ammonia application requires a separate operation but this may be combined with soil tillage. These applications are made with a heavy-duty cultivator equipped with an ammonia tank, and a pump or metering device to regulate the flow of ammonia. High pressure hose or pipe conducts the liquid ammonia to a manifold and then down the backs of the cultivator standards to outlets near the bottom of the shanks. Farmers wishing to try anhydrous ammonia may be able to rent this equipment from dealers supplying the ammonia.

Anhydrous ammonia is stored and handled under pressure. The gas itself can be dangerous. Therefore it is essential that those working with ammonia know how to use and handle it safely. Operators should wear tight-fitting goggles and rubber gloves when adjustments to any parts of the equipment that are under pressure.

Comparisons to date in Alberta between anhydrous and other nitrogen fertilizers have revealed no general differences in their effectiveness when applied at rates supplying equal poundages of nitrogen.

LIQUID FERTILIZERS AND FORTIFIED DUSTS

Tests to date indicate that liquid fertilizers available in Alberta as seed treatments are not effective or economical forms of fertilizers for grains. Liquid fertilizers applied with 2,4-D and other herbicides have not been proven to be profitable for Alberta crops.

Foliar application of fortified dusts, leaf-feeding dust fertilizers or liquid fertilizers are not recommended at present, but experimental work with them is being continued. With the advent of new crops and cropping methods it is possible that more fertilizers will be marketed in a liquid form for farm use. In most instances liquid fertilizers are water solutions of the major plant nutrients which are normally applied in dry granular form. As a liquid they may be somewhat more readily available for the use of the plant at the time of application than comparable dry forms of fertilizer. Special equipment is necessary for their application and several applications are needed to apply the major nutrients in the amounts usually recommended. As a technique for applying minor plant nutrients the use

of liquid forms is quite feasible since only minute quantities are likely to be required. Farmers are urged to consult with their District Agriculturists or Experimental Farms however before investing in liquid fertilizers.

SOIL AMENDMENTS

Soil amendments provide another type of soil improver. They may or may not act as fertilizers. Lime and peat are examples of these materials.

Lime may be used as a soil amendment to correct an acid condition of the soil. As a fertilizer it may serve to supply calcium. **Very few, if any, Alberta soils need lime.** If you suspect that your soil is acid enquire at your District Agriculturist's office or write to the Agricultural Soil and Feed Testing Laboratory, University of Alberta, Edmonton, for instructions on submitting a sample for analysis. A simple test will show whether or not lime is needed.

Peat may be used to improve the physical conditions and moisture-holding capacity of grey wooded soils and clay soils. When properly worked into the soil, well decomposed peat has proven better for this purpose than coarse light-colored peat. Peat lands are found frequently in the grey wooded soil zones, but because of the labor involved application usually is confined to gardens, greenhouses and other small areas.

Farm manure is one of the best soil conditioners available. Because of its value as a fertilizer, it serves a dual purpose.

Chemical soil conditioners are now available. As yet the cost is too great to make their use practical on a large scale. Greenhouse operators and home gardeners may find these chemical soil conditioners useful.

WHAT DOES MY SOIL NEED?

The needs of a soil depend on a number of things. Soils differ greatly from soil zone to soil zone and even within a zone. Therefore your farm location and the kind of crops you grow will help to determine the fertilizer needs of your particular soil.

By referring to the soil zone map of Alberta on page 4 you will be able to determine the zone in which your farm is located. A chemical soil test is often helpful. The District Agriculturist can supply instructions for farmers who wish to have a chemical test made on their soil.

GREY WOODED SOILS AND DEGRADED BLACK (TRANSITION) SOILS

On the Grey Wooded and Degraded Black (Transition) soils nitrogen, phosphorus and sometimes sulphur are the chief fertilizer requirements for grains and grasses. For legumes grown on Grey Wooded soil, sulphur is of major importance except in the Peace River region of Alberta and British Columbia.

On sulphur-deficient soils legumes are greatly benefited by fertilizers supplying sulphur. The sulphur content of various fertilizers is given in Table 1. Fertilizers supplying only sulphur do not help cereals or grasses much, but when cereals or grasses follow sulphur-fertilized legumes, the benefits are large. The data in Table 2 page 14 show that on severely-leached sulphur-deficient soils, use of suitable fertilizers in conjunction with a crop rotation containing legumes may increase grain yields more than 100 per cent.

TABLE 2

Effects of Fertilizers and Crop Rotation on Yields From a Grey Wooded Soil at Breton
(University of Alberta, Soils Dept. Plots)

Average Yield Per Acre, 1930 - 1956

Treatment and approximate rate per acre	Fallow grain system—wheat — fallow (one crop in 2 years)	Five-Year Rotation System (Wheat—Oats—Barley—Hay—Hay) A Crop Every Year				
	Yield of Wheat, bus.	Wheat, bus. (Year 1)	Oats, bus. (Year 2)	Barley, bus. (Year 3)	Legume hay, tons (Year 4)	Legume hay, tons (Year 5)
		Yields from Unfertilized Treatments				
No fertilizer	15.1	13.2	24.4	12.0	0.5	0.3

Yields and Increases for Fertilizer Treatments

	Yield.	Increase.	Yield.	Increase.	Yield.	Increase.	Yield.	Increase.	Yield.	Increase.	Yield.	Increase.
Manure*	29.8	14.7	30.8	17.6	49.6	25.2	25.4	13.4	1.3	0.8	1.2	.9
16-20-0 Plus Pot. Sulph. at approx. 75 lbs.	26.9	11.8	37.9	24.7	54.0	29.6	27.0	15.0	2.5	2.0	2.3	2.0
Ammonium Sulphate at approx. 75 lbs.	24.5	9.4	32.6	19.4	52.9	28.5	26.3	14.3	2.2	1.7	2.1	1.8
Manure* plus 16-20-0 at approx. 75 lbs.	30.0	14.9	33.2	20.0	54.3	29.9	32.0	20.0	2.3	1.8	2.4	2.1
16-20-0 at approx. 75 lbs.	24.8	9.7	28.2	15.0	49.8	25.4	25.7	13.7	2.3	1.8	2.2	1.9

* Manure at 20 tons per acre once in five years.

For grains, grasses or mixtures of grasses and legumes on Grey Wooded soils, except those in the Peace River region, fertilizers such as 16-20-0 have proven best. These fertilizers contain nitrogen and phosphorus as well as sulphur. For clovers, alfalfa, and other legumes properly inoculated with nitrogen-fixing bacteria, 21-0-0, 16-20-0, gypsum, sodium sulphate or flowers of sulphur may be expected to give good results because of their sulphur content.

Suggested rates of fertilizer application for various crops on the Grey Wooded soils and Degraded Black soils will be found in Table 8, pages 24 - 25.

GREY WOODED SOILS IN THE PEACE RIVER REGION

For grains in the Peace River region 11-48-0 usually has been the most profitable fertilizer. In recent years 16-20-0 also has given excellent results. Where crops are to be seeded into heavy combine stubble 16-20-0, 27-14-0, or other high nitrogen fertilizers are recommended because of their higher nitrogen content. Grasses have responded to nitrogen in the form of 33.5-0-0, 21-0-0, 27-14-0 and 16-20-0, the higher percentage nitrogen fertilizers giving the more economical returns. As yet there is no data for tests in this region with 82-0-0. Legumes have shown no response to sulphur, phosphate or other fertilizer elements in the Peace River area. Some data from fertilizer tests in the Peace River region are given in Table 3.

TABLE 3

Average Increase in Yields of Wheat, Oats and Barley on Fallow and Stubble. Peace River Section, 1951 - 1955.

Soil Zone	Crop	Land preparation	No. of tests	Bushels of increase per acre.			
				11-48-0 in pounds/A.		16-20-0 in pounds/A.	
				25	50	60	120
Degraded black and black	Wheat	Fallow	26	8.0	11.6	7.0	9.7
"	"	Stubble	19	5.1	5.9	5.3	7.0
"	Oats	Fallow	13	19.7	23.8	17.5	23.3
"	"	Stubble	13	8.9	11.4	12.7	19.0
"	Barley	Fallow	16	13.6	16.6	13.1	17.9
"	"	Stubble	17	7.5	9.3	10.6	15.2
Grey-wooded	Wheat	Fallow	22	4.2	7.3	5.9	8.8
"	"	Stubble	16	2.7	5.4	4.8	7.4
"	Oats	Fallow	15	11.9	12.6	11.0	19.4
"	"	Stubble	15	9.0	12.7	12.4	19.1
"	Barley	Fallow	16	11.4	15.9	10.3	17.5
"	"	Stubble	15	3.4	7.7	7.3	12.6

PEAT SOILS

Peat soils are common in the Grey Wooded soil zone. Their variability makes it difficult to formulate a fertilizer recommendation. In many cases, however, nitrogen, phosphorus, and potassium are all needed, and so a complete fertilizer gives best results.

Two suggestions are offered for farmers wishing to try fertilizer on peat soils:

1. Compare a nitrogen and phosphorus supplying fertilizer such as 16-20-0 with a complete fertilizer such as 10-30-10 on adjacent parts of the peaty area.

2. Use relatively heavy rates of application (75 to 150 lbs. per acre is suggested).

DARK BROWN AND BLACK SOILS

The prairie and parkland soils of the Dark Brown and Black soil zones usually are short of phosphorus. They normally contain ample sulphur and varying supplies of nitrogen. On these soils fertilizers supplying phosphorus fill the primary need. The results of fertilizer tests on Black and Dark Brown soils (Table 4) show increases obtained from the use of varying amounts of 11-48-0. These trials were conducted on the land of co-operating farmers, using ordinary farm equipment and normal seeding methods.

Many tests with nitrogen supplying fertilizers have been placed on stubble land in recent years. Results have been exceedingly variable. (See the section "Cereal Crops on Stubble").

Recommended rates of fertilizer application may be found in Table 8, pages 24 - 25.

TABLE 4

Average Wheat Yield Increases on Summerfallow in Alberta, 1941-1955

Soil Zone	No. of Tests	Rates of 11-48-0 per acre	
		25 lbs.	50 lbs.
		Increase in Yield Bushels per Acre	
Black and Black Transition (Central Alberta)	63	5.7	7.9
Dark Brown and Thin Black	86	6.9	9.3
Average for	149 tests	6.4	8.7

BROWN SOILS

The Brown soils of Alberta lie in an area where moisture is the greatest limiting factor in crop production. Trials indicate that on the average under good management sufficient nutrients have become available each year under dry land conditions to supply the needs of most crops. However, on soils which have not been managed properly, fertilization may on the average prove beneficial Experiments have indicated that on such soils some response may be obtained from the use of phosphorus fertilizers. This response has been most marked on soils which have been badly drifted. The greatest response occurs when moisture conditions are favorable.

Farmers in the area are urged to discuss their fertilizer problems with their nearest District Agriculturist or Experimental Farm Officials.

IRRIGATED SOILS OF SOUTHERN ALBERTA

All irrigated soils will respond to barnyard manure and commercial fertilizers. Irrigated soils should be intensely farmed and a program of improving and maintaining soil fertility pays off in higher crop returns.

Soils which are in legume crops a large percentage of the time will produce abundant yields if manure is applied at rates equivalent to 2 or 3 tons per acre per year. Because of insufficient amounts, however, high application rates of barnyard manure are rarely possible and farmers must then make use of commercial fertilizers. Most irrigated crops, particularly legumes and sugar beets, require phosphorus. Where no legumes are grown and barnyard manure is not used, nitrogen fertilizer can be used profitably on some soils. To date, there is no indication that the irrigated soils of southern Alberta require potash

FERTILIZER USE IN ALBERTA

DOES IT PAY TO FERTILIZE?

There are many factors involved in the response obtained from fertilizers in Alberta. Year to year variations in local growing conditions, soil moisture, date of seeding, and time of harvesting are among the factors that must be considered. In Table 5 for example you will note the wide difference in response to fertilizers obtained in three years of widely different moisture conditions.

TABLE 5

The Yield of Wheat in Bushels on Soil Science Dept. Plots, University of Alberta — Edmonton.

Year	1947	1948	1949	1930-48
Moisture Conditions	Excellent	Good	Poor	Average
Yields per acre no fertilizer	44.5	42.2	9.2	35.7
Yields per acre fertilized with phosphate	59.9	48.4	10.5	41.4
Increase per acre due to fertilizer	15.4	6.2	1.3	5.7

Because of this variation, using fertilizers on your farm for one year only may not tell the story. You should fertilize for at least three successive years, leaving a check strip unfertilized so that you can make your own comparisons. Only in this way can you assess the true value of the fertilizer used.

A casual visual inspection may not detect important yield increases resulting from fertilizer application. It is often difficult visually to detect a five-bushel-per-acre difference in yield. Such an increase, resulting from fertilizer application, usually would bring a handsome profit.

Generally speaking, it has been profitable to fertilize grasses and grains at recommended rates throughout all soil zones except under dry land conditions in the Brown soil zone. Because of a lack of moisture, fertilizing has not always been profitable in much of the Brown soil zone.

There are frequently benefits besides yield increase from the use of phosphate fertilizers. These benefits may be :

1. Earlier and more uniform maturity.
2. Improved feeding value of some crops.
3. A partial control of weeds resulting from better crop competition.

The extent to which these benefits are obtained vary depending on soil and moisture conditions as well as the area concerned. The earlier maturity usually resulting from phosphorus fertilization is especially valued by farmers in some areas.

Good profits usually are obtained from use of recommended fertilizers on fallowed land. Table 4, page 16 gives the average yields for central and southern Alberta. An average increase of 8.7 bushels of wheat per acre was realized from an application of 50 pounds per acre of 11-48-0 at a cost of about $2.70. Similar profitable results have been obtained from fertilization of oats and barley grown on summerfallow.

Comparison of fertilizer costs with the increased yields obtained on Grey Wooded and Degraded Black (Transition) soils will show even greater profits. See, for example, Table 2 or obtain a copy of Bulletin No. 21, "Grey Wooded Soils and Their Management", from the University of Alberta.

METHODS OF APPLICATION

There are several methods of applying fertilizer, each of which has its advantages. The method to be used depends on the crops, soil, climate, date and rate of application, kind of fertilizer, and equipment available. The aim should be to get the fertilizer into the soil where it will do the most good.

Several types of fertilizer machinery are now on the market. Combination fertilizer-seed drills and attachments that can be used with several different seed drills are available. The attachments are the most common.

Broadcast spreaders are of two types, the one kind resembling a grain drill while the second type consists of a power take-off attachment with a hopper and cyclone-seeder type of spreader. Specially-designed side-dressing applicators for row crops also are being used on Alberta farms and ranches. Special equipment is used for the application of anhydrous ammonia. (See page 12)

A worn-out grain drill may be used to apply the recommended amounts of fertilizer to hay crops and stubble fields. Fertilizer will very rapidly corrode and wear the parts of any drill. Do not use a machine which is still useful for seeding grain.

Usually it is necessary to broadcast fertilizers when they are applied at high rates. There are two reasons for this: Firstly, it is seldom possible to get equipment which can apply these poundages while seeding grain at the same time. Secondly, if large amounts of fertilizer are placed in the ground touching the seed, germination may be adversely affected. This applies particularly to nitrogen. No more than 30 to 40 pounds of elemental nitrogen should be drilled in with wheat, oats, or barley for example. Half this amount would be a maximum for flax. Nitrogen fertilizers may be applied, broadcast in the fall or in the spring either as a separate operation or when carrying out an ordinary tillage operation. These fertilizers are highly soluble and will wash into the soil with the first rain. However, in Alberta they probably will not leach down in the soil beyond the reach of crop roots.

Commercial fertilizers have been tested by governmental agencies on a variety of crops throughout Alberta for many years, and on this basis the following recommendations are outlined.

CARE OF FERTILIZERS AND EQUIPMENT

The granular commercial fertilizers referred to in this publication can be stored without difficulty if the following simple rules are followed:

1. Fertilizers must be kept dry. Stack the bags on a wooden platform rather than on a dirt or concrete floor. Keep rain and snow out. Keep mice away.

2. Stack fertilizer bags no more than twelve bags high to avoid compaction at the bottom of the pile, and leave spaces between the piles for ventilation.

3. Fertilizers may cause trouble if eaten directly by livestock. Clean up spilled fertilizer and keep livestock out of your fertilizer store room.

Fertilizer attachments require special care if they are to give good service. When not in use they should be covered and kept dry. Wet fertilizers cake and also corrode metals with which they are in contact. After use the attachments should be **thoroughly** cleaned out and the equipment then stored in a dry place. A light coating of fuel oil will also help to prevent corrosion.

FERTILIZER USE ON CROPS NOT IRRIGATED

CEREAL CROPS ON FALLOW

Grain crops do best when fertilizers are drilled in with the seed. This places the fertilizer where the young plants can use it readily. Use a fertilizer attachment on your grain drill or a combination fertilizer-grain drill. Do not mix fertilizer with the grain in the ordinary seed drill, because the rate of seeding and fertilizer application are likely to be uneven. Moreover, this method of fertilizer application usually causes excessive corrosion and wear in the drill. Recommended rates of fertilizer application will be found in Table 8, pages 24 - 25.

CEREAL CROPS ON STUBBLE

The generally lower yields of crops grown on stubble land as compared with those grown after fallow is widely recognized. During a summerfallow year nitrogen available to crops accumulates in the soil due to decomposition of soil humus and organic matter. The available supply of some other essential plant nutrients also is increased when land is fallowed. These extra available nutrients, the control of weeds and the small amount of moisture saved by fallowing are responsible for the better yields on such land.

Stubbled-in-crops must get along with only the nutrients which become available as the crop is growing. If the land in question is in a good state of fertility and has been producing good crops and if there is not too much trash, then 16-20-0 or 11-48-0 generally will give profitable yield increases as shown in Tables 3 and 6. If, however, the soil has only a limited supply of nutrients and large amounts of stubble and combine straw are present a stubbled-in crop may be severely handicapped. With favorable climatic

TABLE 6

Yields increases in bushels per acre resulting from fertilization of grain crops grown on stubble. Central Alberta — 1946 - 1957.

Crop	No. of Tests	Yield without Fertilizer	Kind of Fertilizer		
			11-48-0 lb. per acre		16-20-0 lb. per acre
			25	50	60
			Bushels of Increase		
Wheat	19	21.0	2.4	5.0	4.3
Oats	11	33.2	8.1	9.2	8.5
Barley	50	25.1	4.5	7.8	7.5

conditions, micro-organisms in such soils will multiply rapidly and compete with the growing crop for nutrients, particularly nitrogen. With insufficient readily available nitrogen the crop will appear a pale yellow-green color and yield will be reduced. Applications of fertilizers supplying mainly nitrogen in such cases may prove to be quite profitable.

Various nitrogen fertilizers have been tried on stubble fields in many parts of Alberta in recent years and the following findings have resulted:

1. Although results have been highly variable even in the same district, between 1/3 and 1/2 of the fields tested have given profitable yield increases from the use of nitrogen fertilizers.

2. Where nitrogen fertilizers are used the recommended application of phosphate should be applied at seeding time. (See Table 8).

3. Nitrogen fertilizers may be applied in the fall or in the spring. No difference in effectiveness as yet has been found in Alberta.

4. Three nitrogen fertilizers are currently available in Alberta; anhydrous ammonia, ammonium nitrate and ammonium sulphate. Tests to date have shown no difference in the effectiveness of the nitrogen in these three forms. However, sulphur in ammonium sulphate will be beneficial on sulphur deficient grey soils where legumes are to be grown.

5. In general, the fields showing the greatest response to nitrogen fertilization are those which have been cropped for many years and are now showing a definite drop in productivity.

6. In several tests low rates of application of nitrogen resulted in only small increases in yield while in the same fields a high rate of application brought about a large increase in yield. (See Table 7). There appears

TABLE 7.

Average yield increases in bushels per acre resulting from nitrogen fertilization of grains grown in fields having combine straw. Central Alberta (Clyde to Carstairs), 1949 - 1957.

Crop.	Yield without fertilizer.	No. of tests.	Pounds per acre of nitrogen applied.			
			33		67	
			Bus. of increase.	No. of tests.	Bus. of increase.	No. of tests.
Wheat	27.3	17	4.3	16	11.5	12
Oats	41.3	28	10.2	25	20.7	16
Barley	31.5	47	6.7	41	10.7	21

NOTE:—Twenty of the above tests were conducted in 1955 and in those tests the normal phosphate application of 50 lbs. per acre of 11-48-0 was made at seeding time to one-half of each area fertilized with nitrogen. In 19 of the 20 tests the phosphate application increased yield, the average increase for all grains on all farms being 290 pounds of grain per acre.

to be a critical level of nitrogen somewhere between 30 and 60 pounds per acre which must be exceeded before yields are increased. This critical level varies from soil to soil no doubt, also from season to season, and with the amount of stubble and straw present at seeding time.

7. The most economical rates of nitrogen fertilization have not been accurately determined as yet, and it is suggested that anyone suspecting nitrogen starvation of crops grown on stubble land should put down test strips using rates varying from 20 to 60 pounds per acre of actual nitrogen. See Table 10, page 28, for rate of the various nitrogen fertilizers to give the required poundage of nitrogen.

FORAGE CROPS

Forage crops are assuming a role of increasing importance in Alberta agriculture. Accordingly, more tests to determine fertilizer needs of these crops have been conducted in recent years. In general, profits from fertilization of forage crops compare favorably with profits from fertilizer use on grain. Results from hay fertilization are profitable especially when legumes growing on sulphur-deficient Grey Wooded soil are fertilized. (See Table 2, page 14).

Recommendations for fertilization of hays vary with soil zones, soil textures, and kind of hay. In the Dark Brown and Black soil zones, grass hays generally respond to nitrogen or to nitrogen and phosphorous. In these areas phosphorus is the most important need of legumes. On sandy soils legumes may also respond to nitrogen although this may be due to poor inoculation of the legume. In the Black and Dark Brown soil zones the need for nitrogen as well as phosphorus when fertilizing grass-legume mixtures will depend on the proportions of the two kinds of plants. On sandy soils or when the proportion of grass is high, nitrogen as well as phosphorus usually will be needed. On the sulphur-deficient Grey Wooded soils west and north of the central Alberta Black soil zone legumes and legume-grass mixtures respond primarily to sulphur and phosphorus. Peats are highly variable. On them a fertilizer supplying nitrogen and phosphorus such as 16-20-0 or a complete fertilizer usually will give best results.

Any of the equipment described in the section "Methods of Application" (page 18) may be used to fertilize hays. Nitrogen fertilizer may be applied in the late fall or early spring when hay is the crop to be harvested. If grass is being grown for seed production, nitrogen fertilization immediately after seed harvest is recommended. Best results from phosphate fertilization usually are obtained when applications are made very early in the spring. Sulphur fertilization of legumes may be done at any convenient time. On established stands of alfalfa, broadcasting of fertilizer is recommended because of the danger of spreading bacterial wilt with the furrow openers on a standard drill.

Yield increase is not the only benefit from forage fertilization. The protein content and the general nutritive value of hay often are improved. In addition, phosphate fertilization frequently will help maintain the legume in a grass-legume mixture.

Do not mix inoculated legume seed with fertilizer. The fertilizer may harm the nitrogen fixing bacteria, and fertilizer sticking to the moist seed may lower germination.

Recommendations for fertilization of forage crops are given in Table 8, pages 24 - 25.

FRESHLY BROKEN SOD

When brome grass, creeping red fescue and some other fibrous sods are broken up special fertilizer practices are often needed. Soils in such fields usually are low in their supply of available nitrogen and additional nitrogen is often needed to promote decomposition of the root fibre. When this type of sod is broken after early July nitrogen fertilization is likely to be beneficial if the land is to be cropped the following year.

Because of an inadequate number of field tests specific recommendations can not be made as yet. Those wishing to test a nitrogen fertilizer in such a case are advised to use 30 - 60 pounds per acre of nitrogen on a part of the field. This application of nitrogen may be made after breaking or in early spring. The recommended application of phosphorus fertilizer should be made at seeding time.

POTATOES

Fertilizer trials on potato crops have not been extensive, but from those conducted promising results have been obtained. Application of 11-48-0 fertilizer at planting time, placed in bands slightly below and to the side of the seed pieces, has given good results.

TABLE 8.

RECOMMENDED RATES OF FERTILIZER APPLICATION FOR ALBERTA CROPS

(Pounds per acre of nutrients recommended. Table 10 can be used to determine pounds of commercial fertilizer to use.)

BROWN ZONE

Fertilizers not generally recommended here except on heavy textured soils when moisture reserves are good.

Nutrient	Coarse Grains *	Hay	Grasses for seed
N (Nitrogen)	5	20 to 40	25 to 50
P_2O_5 (Phosphate)	15	—	—
	11-48-0 @ 30 [1]		

	Nutrients N = nitrogen P_2O_5 = phosphate	DARK BROWN & THIN BLACK ZONES	BLACK & DEGRADED BLACK**
CROPS			
Wheat, oats, barley			
On fallow (drilled in)	N	5 lb./ac.	5 lb./ac.
	P_2O_5	20	25
		11-48-0 @ 40 [1]	11-48-0 @ 50 [1]
On stubble or after cover crop			
(a) Light stubble or trash (drilled in application)	N	10	15
	P_2O_5	15	15
		16-20-0 @ 75 [1]	16-20-0 @ 85 [1]
(b) Heavy stubble or trash or following sod breaking. (Broadcast most of the N, drill in the P_2O_5. See page 20)	N	25 to 40	30 to 45
	P_2O_5	20	25
Grasses grown for seed			
(Broadcast after seed harvest)	N	25 to 80	40 to 100
	P_2O_5	0 to 85	10 to 45
Grasses grown for forage			
(Broadcast in early fall or early spring)		Same rates as above	
Grass-legume hay mixture			
(a) With less than 25% legume	N	20 to 45	25 to 50
	P_2O_5	10 to 30	15 to 40
(b) With over 25% legume	N	10 to 15	10 to 20
	P_2O_5	35 to 70	50 to 80
		11-48-0 @ 75 to 150 [1]	11-48-0 @ 100 to 165 [1]
Legumes for forage or seed	N	Same as for hay mixture.	
	P_2O_5	with over 25% legume.	
Flax, rape, mustard, rye			
(NOTE:—Few official tests have been done on these crops. Rates are suggestions.)			
On fallow	N	5	5
	P_2O_5	15	20
		11-48-0 @ 30 [1]	11-48-0 @ 40 [1]
On stubble or sod breaking (Broadcast most of the N, drill in the P_2O_5. See page 20).	N	35	45
	P_2O_5	15	20
		33.5-0-0 @ 100 11-48-0 @ 30 [1]	35.5-0-0 @ 120 11-48-0 @ 40 [1]

[1] Easiest way to apply recommended levels of N and P_2O_5.

* Wheat, oats, barley. Few tests to date on rape, flax, mustard.

** Recommendations for the Degraded Black soils of the Ft. Vermilion area are given on next page.

TABLE 8—Continued

GREY WOODED SOIL ZONE

Crop	Nutrients	Area west and north or main Black zone. (Note in Table 2the value of rotations and sulphur-containing fertilizers.)	Peace River Region. (Rotations are necessary but sulphur not important.)
Grains			
On fallow or light stubble (Drilled in Application)	N	10 lb./ac.	5 lb./ac.
	P_2O_5	10 to 15	20
	S	0 - 10	
		16-20-0 @ 70 [1]	11-48-0 @ 40 [1]
On heavy stubble (Broadcast most of the N but drill in the P_2O_5. See Page 20.)	N	25 to 35	20 to 40
	P_2O_5	20	10 to 20
	S	0 - 20	
		21-0-0 @ 100 to 150 [1]	27-14-0 @ 75-100 OR 33.5-0-0 @ 70 + 11-48-0 @ 40 [1]
Flax, fall rye			
(Tentative recommendation)	N	10	5
	P_2O_5	10	20
	S	0-10	
		16-20-0 @ 50 [1]	11-48-0 @ 40 [1]
Grasses for seed			
(Broadcast after seed harvest)	N	20 to 50	30 to 50
	P_2O_5	0 to 30	0 to 30
	S	0 to 20	0
		21-0-0 or 16-20-0 [1]	33.5-0-0 or 27-14-0 [1]
Grasses for forage			
	N	15 to 40	Same as above
	P_2O_5	0 to 25	
	S	0 to 15	
		21-0-0 or 16-20-0 [1]	
Grass-legume mixtures (If over 25% legume reduce N to minimum)	N	15 to 30	(Use same rates as for Dark Brown Zone, Page 24.)
	P_2O_5	0 to 30	
	S	20 to 50	
Legumes for seed			
Broadcast when planted or on established stand	N	10	
	P_2O_5	10 to 15	
	S	10	
		16-20-0 @ 50 to 75 [1]	

DEGRADED BLACK SOILS OF FT. VERMILION AREA

(Tests to date, although limited in number suggest the following :)

Wheat, oats, barley, flax On fallow :	N	5	11-48-0 @ 40 [1]
	P_2O_5	20	
On light to medium stubble or trash	N	10	16-20-0 @ 75 [1]
	P_2O_5	15	
On heavy stubble or trash and following grass breaking: (Broadcast most of the N, drill in the P_2O_5. See Page 20.)	N	25 to 35	
	P_2O_5	15 to 20	

[1] Easiest way to apply recommended levels of N, P_2O_5, and S.

FERTILIZER USE ON IRRIGATED SOILS

CEREAL CROPS UNDER IRRIGATION

In well planned rotations the fertilizer program should be such that the applications be made to favor the most remunerative cash crops — usually the row crops. Residual manure and commercial fertilizer in such a rotation usually benefit the cereal crops sufficiently to produce abundant yields. In new areas where no manure has been used or in areas where the fertility of the soil is relatively low, farmers should consider using 100 to 150 pounds per acre of 16-20-0 or 27-14-0.

FORAGE CROPS UNDER IRRIGATION

There does not appear to be any advantage in applying fertilizers to forage crops at the time of planting. Broadcast the fertilizers on an established stand for best results. One hundred pounds per acre of 11-48-0 should be broadcast on alfalfa fields in early spring every two to three years. The recommended practice for irrigated pasture is to broadcast 100 pounds of 11-48-0 per acre in early spring and follow with a second application of 20 - 35 pounds per acre of nitrogen in June.

SUGAR BEETS

The recommended practice is to apply 100 pounds per acre of 11-48-0 for all sugar beets at the time of seeding. The use of 16-20-0 or 27-14-0 applied in close contact with the seed at planting time could decrease the germination if applied at high rates when soil moisture is at a low level Nitrogen fertilizer should never be placed in close contact with any row crop seeds. If the soil is lacking in nitrogen, granular fertilizer or 82-0-0 at rates equivalent to 70 pounds of nitrogen per acre, should be used in addition to the 100 pounds per acre of 11-48-0. The granular fertilizer could be broadcast and worked into the soil either in late fall or in spring prior to planting. If 82-0-0 is used it could also be applied at these times and either form of nitrogen fertilizer could also be used as a side dressing immediately after the beets are thinned.

CANNING CORN

If the soil is fairly fertile, 80 pounds per acre of 11-48-0 should be used. On less fertile soils 150 pounds per acre of 16-20-0 or 27-14-0 might be substituted. Farmers should be careful not to place large amounts of fertilizers in close contact with seeds, particularly in dry years.

BEANS AND PEAS

The germination of field beans is decidedly reduced if fertilizers are placed in close contact with the seed. Fifty pounds of 11-48-0 per acre could be used and this should be applied in separate bands or broadcast and worked into the soil prior to planting.

FERTILIZING GARDEN AND LAWNS

A publication dealing with this topic is available from the Department of Extension, University of Alberta. It is entitled, "Soils and Fertilizers for Alberta Gardens and Lawns".

TABLE 9.

RECOMMENDED RATES OF FERTILIZER APPLICATION FOR IRRIGATED CROPS IN ALBERTA

(Pounds per acre of nutrients recommended. Table 10 can be used to determine pounds of commercial fertilizer to use.)

Nutrient	Sugar Beets	Canning Corn	Peas & Beans	Potatoes	Grains
N =-nitrogen					
P_2O_5 = phosphate		(Drilled in near or with the seed)			
N	10*	10**	5	15	40
P_2O_5	40	40	25	60	20
	11-48-0 @ 80 [1]		11-48-0 @ 50 [1]	11-48-0 @ 150 [1]	

	Alfalfa hay	Grass-legume pasture
	(Early spring top-dressing)	
N	10	10***
P_2O_5	50	50
	11-48-0 @ 100 [1]	11-48-0 @ 100 [1]

* Add to this a side-dressing of 50 to 70 pounds of N where needed.

** Add to this a side-dressing of 40 to 60 pounds where needed.

*** Follow up with a top-dressing in June of 40 pounds of N. To maintain peak production during late summer a further application in early August might be considered.

[1] Recommended fertilizer and rate to supply nutrients in amounts suggested.

TABLE 10.

POUNDS OF COMMERCIAL FERTILIZERS REQUIRED TO SUPPLY VARIOUS QUANTITIES OF N, P_2O_5 AND S.

Pounds of nutrient desired	Commercial fertilizers available								
	82-0-0	35.5-0-0	21-0-0	11-48-0	16-20-0	23-23-0	24-20-0	27-14-0	10-30-10
Nitrogen (N)									
5 lbs.	*	15	24	45	31	22	21	19	50
10 "	*	30	48	*	62	43	42	37	*
15 "	18	45	71	*	94	65	62	56	*
20 "	24	60	95	*	125	87	83	74	*
25 "	30	75	119	*	*	109	104	93	*
30 "	37	90	143	*	*	130	125	111	*
35 "	43	105	167	*	*	*	146	130	*
40 "	49	120	190	*	*	*	*	148	*
45 "	55	134	214	*	*	*	*	167	*
50 "	61	149	238	*	*	*	*	185	*
Phosphate (P_2O_5)									
5 lbs.	No P_2O_5 present	No P_2O_5 present	No P_2O_5 present	10	25	22	25	36	15
10 lbs.				21	50	43	50	71	30
15 lbs.				31	75	65	75	*	45
20 lbs.				42	100	87	100	*	60
25 lbs.				52	125	109	125	*	75
30 lbs.				62	150	130	150	*	90
35 lbs.				73	175	152	175	*	*
40 lbs.				83	200	174	200	*	*
Sulphur (S) **									
5 lbs.	No S present	No S present	20	Little S present	36	Little S present	Little S present	Little S present	100
10 lbs.			40		71				*
15 lbs.			60		107				*
20 lbs.			80		143				*
25 lbs.			100		*				*
30 lbs.			120		*				*

* Some other fertilizer more desirable to supply this quantity of nutrient.

** In addition to 10-30-10, 16-20-0, and 21-0-0 which contains 5%, 14%, and 25% sulphur respectively, S may also be applied by using gypsum (18% sulphur), sodium sulphate (22% sulphur) or pure sulphur.

NOTES

NOTES

THE ALBERTA ADVISORY FERTILIZER COMMITTEE

The Alberta Advisory Fertilizer Committee supervises test work each year, and its recommendations provide a consensus of authoritative opinions of specialists in this field.

Much of the earlier test work supervised by the Committee was with wheat on summerfallowed land in the dark brown, thin black and black soil zones. However in recent years tests on all grain crops on stubble and fallowed land have been conducted and all soil zones are receiving attention. Tests are also being made on forage crops grown for hay and seed production. It is important to realize that a large number of tests over a large area and over a number of years are needed before sound recommendations for fertilizer use can be made. The Committee is endeavoring to have tests carried out in all parts of the province using fertilizers on the market. New fertilizers appearing on the market receive the Committee's close attention and are included in the tests conducted.

Results of the tests indicate that best use is not being made of fertilizers. Many farmers not using fertilizers would obtain profitable yield increases by their use.

The duties of the Alberta Advisory Fertilizer Committee are:

1. To co-ordinate and guide in so far as is possible fertilizer investigations and testing in Alberta.
2. To assemble and examine experimental data from the testing of fertilizers in Alberta.
3. To make recommendations for the use of fertilizers in Alberta.
4. To publicize recommendations of the Committee with a view to encouraging good soil management practices.
5. To safeguard the interests of agriculture by arranging for the testing of fertilizers under practical farm conditions so that recommendations of the Committee will be supported by practical experimental data.

DISCUSS YOUR FARM PROBLEMS WITH YOUR DISTRICT AGRICULTURIST

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